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Effect of feed presentation on feeding patterns of dairy calves

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ABSTRACT

The objectives of this study were to determine the effect of feed presentation on meal frequency and duration, as well as diurnal feeding patterns of dairy calves, and to assess any longer-term differences in feeding patterns resulting from previous experience. Twenty Holstein bull calves were exposed from wk 1 to 8 of life to 1 of 2 feed presentation treatments: concentrate and chopped grass hay (<2.5 cm) offered at a ratio of 7:3 as a mixture (MIX), or as separate components (COM). Feed was provided ad libitum. Calves received 8 L/d of milk replacer (1.2 kg of dry matter), with the amount progressively reduced after 5 wk to facilitate weaning by the end of wk 7. At the beginning of wk 9, all calves received the MIX diet and remained on trial for an additional 3 wk. Feeding behavior was recorded from video for 4 d during wk 6, 8, 9, and 11. In wk 6, calves fed MIX spent more time feeding than calves fed COM (56.7 vs. 46.8 min/d). In wk 8, calves fed MIX spent more time feeding (174.0 vs. 139.1 min/d) and had a lower rate of intake (11.5 vs. 14.7 g/min) compared with calves fed COM. Meal frequency was similar between treatments (12.2 meals/d). Diurnal feeding patterns in wk 8 were also affected by feed presentation, with calves fed MIX spending less time feeding at time of feed delivery and more time feeding throughout the rest of the daylight hours than calves fed COM. Diurnal feeding patterns of hay and concentrate in wk 8 differed for calves fed COM, with more time spent consuming hay at time of feed delivery and less time spent consuming hay throughout the rest of the day. Once calves previously fed COM were transitioned to the MIX diet in wk 9, meal frequency, meal duration, and diurnal feeding patterns were similar between treatments: both treatments spent similar amounts of time feeding (173.9 min/d) and had similar peaks in feeding activity at time of feed delivery, sunrise, and sunset. Provision of hay and concentrate to young calves as a mixed ration, compared with separate components, increases time spent feeding and results in more evenly distributed diurnal feeding patterns. However, differences in feeding patterns resulting from feed presentation did not persist after 8 wk of age, when all calves were fed a mixed ration.

Key words: dairy calf, feeding pattern, feed presentation

INTRODUCTION

Feeding patterns of dairy cattle are influenced by the manner in which feed is presented. Providing concentrate and forage as separate components encourages rapid intake of the concentrate component at the time of feed delivery before consuming forage in both growing heifers (DeVries and von Keyserlingk, 2009; Greter et al., 2010a) and adult cattle (Maekawa et al., 2002). In contrast, providing concentrate and forage as a TMR to heifers results in increased daily feeding time, lower rates of intake, and longer meals compared with providing these feed types as separate components (DeVries and von Keyserlingk, 2009). Similarly, adult cattle provided a TMR spend more time eating at a lower rate of intake compared with cattle provided forage and concentrate as separate ingredients (Maekawa et al., 2002). Heifers provided a TMR also have more evenly distributed diurnal feeding patterns than heifers provided separate components (DeVries and von Keyserlingk, 2009; Greter et al., 2010a). Evidence suggests that the effect of feed presentation on intake patterns may affect rumen health, given that intake of concentrate without adequate physically effective fiber results in rapid fermentation and decreased rumen pH, increasing the risk of ruminal acidosis (Beauchemin et al., 2002; Krause and Oetzel, 2006). Also, rumen pH decreases following meals, with the extent of the decline increasing with meal size (Allen, 1997; Bach et al., 2007). Thus, feeding patterns exhibited by cattle fed a TMR encourage moderation of rumen fermentation.

When young calves have access to concentrate and forage, these components are commonly presented separately (Vasseur et al., 2010). Intake of concentrate

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provides energy for growth (Hill et al., 2008) and supports the development of rumen papillae (Tamate et al., 1962), whereas intake of hay alongside concentrate improves feed efficiency (Coverdale et al., 2004) and the rumen environment (Suárez et al., 2007; Khan et al., 2011). However, no work to date has examined how the manner in which concentrate and hay are presented—separately or as a mixture—affects the feeding patterns of young calves around the time of weaning.

Furthermore, feeding experiences early in life may influence development of feeding behavior in young ruminants, affecting feed preferences (Nolte et al., 1990) and feeding motor skills (Arnold and Maller, 1977; Provenza and Balph, 1987). Interestingly, Greter et al. (2010b) found that weaned heifers previously exposed to a top-dressed ration (grain concentrate placed on top of forage) spent more time feeding in response to fresh feed delivery after transition to a TMR compared with heifers previously fed the TMR. Greter et al. (2010b) speculated that this effect reflected the persistence of feeding patterns learned while heifers were fed the top-dressed ration. These results suggest that if feeding patterns of dairy calves are influenced by feed presentation, the potential may exist for differences in feeding patterns to persist once all animals are later provided a mixed ration.

Therefore, the objectives of this study were to assess the effect of feed presentation (hay and concentrate provided as separate components or a mixed ration) on the feeding patterns of dairy calves during the milk feeding stage and around the time of weaning, and to assess whether any differences in feeding patterns persist after transition to a common mixed ration. Our first hypothesis was that providing a mixed ration may result in more evenly distributed diurnal patterns of feeding behavior and a reduced response to feed delivery compared with providing separate feed components. Second, we hypothesized that prior exposure to feed types as separate components may result in longer-term differences in feeding patterns upon transition to the mixed ration compared with calves previously exposed to the mixed ration.

MATERIALS AND METHODS

Animals and Housing

This study was completed concurrently with another study (Miller-Cushon et al., 2013), in which the effect of feed presentation on the development of feed sorting behavior was assessed. Thus, calf management is described in detail by Miller-Cushon et al. (2013). In brief, 20 male Holstein calves were used in this study. Calves were housed within individual pens (1.2 × 1.8 m; width × depth) at the University of Guelph Kemptville Campus Dairy Education and Research Centre (Kemptville, ON, Canada) and were managed according to the standard operating procedures of this research station, in accordance with guidelines set by the Canadian Council on Animal Care (2009). The front of each pen had 2 openings for access to feed pails (diameter = 25.4 cm, height = 23.0 cm, capacity = 8 L) mounted on the outside. For the first 7 wk of life, all calves were fed milk replacer (Shur-Gain High Performance Milk Replacer; Nutreco Canada Inc., Guelph, ON, Canada) via an artificial teat (Peach Teats, Skellerup Industries Ltd., New Zealand). All calves were fed twice daily at 0800 and 1600 h a fixed amount of 8 L/d (1.2 kg of DM) for the first 4 wk. Calves were weaned by reducing the amount of milk replacer offered to 6 L/d (0.9 kg of DM) during wk 5, 4 L/d (0.6 kg of DM) during wk 6, and incrementally reduced during wk 7 (in d 1 to 4, calves were offered 3 L/d and in d 5 to 7, calves were offered 2 L/d).

Experimental Design and Treatments

Upon enrollment in the study, calves were randomly assigned to 1 of 2 feed presentation treatments. The treatment diets were (1) concentrate and chopped hay (<2.5 cm) offered at a ratio of 7:3 as a mixture (**MIX**), and (2) concentrate and chopped hay (<2.5 cm) offered at a ratio of 7:3 as separate components (**COM**). These diets were provided ad libitum. Actual orts were similar between treatments: in wk 8, 17.0 ± 3.1% of offered DM ($P = 0.4$). For calves fed COM, concentrate orts were 12.2 ± 5.2% of offered concentrate DM (mean ± SD) and hay orts were 25.5 ± 8.5% of offered hay DM. The front of each pen had 2 openings for access to feed pails (diameter = 25.4 cm, height = 23.0 cm, capacity = 8 L) mounted on the outside. Calves remained on their respective feed presentation treatments throughout the milk-feeding stage (wk 1 to 7) and for 1 wk following removal of milk (wk 8).

Following the period of feed presentation exposure in wk 1 to 8, all calves were offered the MIX diet for an additional 3 wk (wk 9 to 11) to assess the longer-term effects of prior exposure to different feed presentations.

On the days on which behavior was recorded from video, feed intake was determined by weighing the quantity of feed provided and the amount of feed refused. For determination of DMI on these days, fresh feed was sampled weekly and individual orts from each calf were sampled twice weekly (on d 1 and 4), just before removal and delivery of fresh feed. For calves fed COM, weekly samples were taken of both concentrate and hay in wk 1 to 8. Samples taken for DM analysis were oven-dried at 55°C for 48 h.